ON A THREE-DIMENSIONAL LONG PERIOD NON SINUSOIDAL ALFVEN WAVES IN THE SOLAR

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Alfven waves are considered propagating in a radial external magnetic field, in the presence of an uniform radial mean flow. These conditions lead to a second-order convected Alfvén wave equation, for the velocity perturbation. The wave equation has a regular singularity at the critical layer, where the mean flow and Alfvén speeds are equal. The other two singularities are the center, which is a regular singularity, and the point-at-infinity, which is an irregular singularity. It is possible to reduce the differential equation to a Gaussian hypergeometric type, for which all three singularities are regular. Thus the wave field can be calculated exactly at all distances, for all values of dimensionless frequency and Alfvén number, including analytic continuation across the critical layer ; these solutions are illustrated, as plots of amplitude and phase of the wave field, versus radial distance, for various choices of boundary and or radiation conditions. It is shown that the critical layer reflects and absorbs waves, i.e. inside the critical layer waves propagate inward and outward, and outside the critical layer they propagate only outward; the wave spectrum does not vary much with distance up to the critical layer, where wave absorption is greater for higher frequencies. Outside the critical layer, the amplitude of the lower frequency waves decays faster, so that the spectrum evolves so as to re-emphasize the higher frequencies. Thus Alfvénic wave spectrum steepens towards higher frequencies, as observed in the solar wind.